



## COURSE OUTLINE: HET815 - FUEL SYSTEMS

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Approved: Corey Meunier, Chair, Technology and Skilled Trades

<b>Course Code: Title</b>	HET815: FUEL SYSTEMS
<b>Program Number: Name</b>	6086: HDE TECH LEVEL III
<b>Department:</b>	MOTIVE POWER APPRENTICESHIP
<b>Semesters/Terms:</b>	20W
<b>Course Description:</b>	Upon successful completion the apprentice is able to recommend the testing and servicing procedures for diesel fuel injection partial-authority engine management systems, is able to recommend repairs for diesel fuel injection full-authority engine management systems and is able to interpret the exhaust emissions produced by diesel engines following manufacturers' recommendations.
<b>Total Credits:</b>	5
<b>Hours/Week:</b>	5
<b>Total Hours:</b>	40
<b>Prerequisites:</b>	There are no pre-requisites for this course.
<b>Corequisites:</b>	There are no co-requisites for this course.
<b>Essential Employability Skills (EES) addressed in this course:</b>	<p>EES 1 Communicate clearly, concisely and correctly in the written, spoken, and visual form that fulfills the purpose and meets the needs of the audience.</p> <p>EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication.</p> <p>EES 3 Execute mathematical operations accurately.</p> <p>EES 4 Apply a systematic approach to solve problems.</p> <p>EES 5 Use a variety of thinking skills to anticipate and solve problems.</p> <p>EES 6 Locate, select, organize, and document information using appropriate technology and information systems.</p> <p>EES 7 Analyze, evaluate, and apply relevant information from a variety of sources.</p> <p>EES 8 Show respect for the diverse opinions, values, belief systems, and contributions of others.</p> <p>EES 9 Interact with others in groups or teams that contribute to effective working relationships and the achievement of goals.</p> <p>EES 10 Manage the use of time and other resources to complete projects.</p> <p>EES 11 Take responsibility for ones own actions, decisions, and consequences.</p>
<b>Course Evaluation:</b>	Passing Grade: 50%, D
<b>Other Course Evaluation &amp; Assessment Requirements:</b>	<p>Grade</p> <p>Definition Grade Point Equivalent</p> <p>A+ 90 - 100% 4.00</p> <p>A 80 - 89%</p> <p>B 70 - 79% 3.00</p> <p>C 60 - 69% 2.00</p>



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D 50 - 59% 1.00  
 F (Fail) 49% and below 0.00

CR (Credit) Credit for diploma requirements has been awarded.  
 S Satisfactory achievement in field /clinical placement or non-graded subject area.  
 U Unsatisfactory achievement in field/clinical placement or non-graded subject area.  
 X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.  
 NR Grade not reported to Registrar`s office.  
 W Student has withdrawn from the course without academic penalty.

**Course Outcomes and Learning Objectives:**

Course Outcome 1	Learning Objectives for Course Outcome 1
<p>Upon successful completion the apprentice is able to recommend the testing and servicing procedures for diesel fuel injection partial-authority engine management systems following manufacturers` recommendations.</p>	<p>5.1.1 Explain the fundamentals of partial-authority, electronic diesel engine management systems.            - purpose, function, types, styles, and application inline system electronic engine management controls distributor systems            - fundamentals enhancement transducers thermister negative/positive coefficient potentiometers magnetic engine timing requirements            o static            o electronic advance            - overview of inline and distributor pump systems adapted electronic engine controls</p> <p>5.1.2 Identify the construction features of partial-authority, electronic diesel engine management systems and components.            - inline system rack actuators rack position sensors brushless torque motors (BTM) transducers            - distributor systems inlet metering sleeve metering timing controls hydraulic head controls            - electronic controls servo controls pulse wheels linear magnet variable timing control electronic governor hall effect sensor            - hydraulic injectors hydraulic nozzle holders pintle nozzles multi-orifii nozzles</p>

- high pressure pipes
- leak- off lines
- fuel manifolds

5.1.3 Describe the principles of operation of partial-authority, electronic diesel engine management systems and components.

- inline system
- rack actuators
- rack position sensors
- brushless torque motors (BTM)
- transducers
- distributor systems
- inlet metering
- sleeve metering
- timing controls
- hydraulic head controls
- electric controls
- servo controls
- pulse wheels
- linear magnet
- variable timing control
- electronic governor
- hall effect sensor
- hydraulic injectors
- hydraulic nozzle holders
- pintle nozzles
- multi-orifii nozzles
- high pressure pipes
- leak- off lines
- fuel manifolds

5.1.4 Demonstrate inspection, testing and diagnostic procedures following manufacturers' recommendations for partial-authority, electronic diesel engine management systems and components.

- identify components and their location
- recommended tests on system input sensors and output devices
- reader/programmer/personal computer software diagnostics on the inline systems

5.1.5 Recommend reconditioning or repair procedures following manufacturers' recommendations for partial-authority electronic diesel engine management systems and components.

- outline the recommended repair procedures for fuel injection systems
- electronic connections
- wiring harness
- connector repairs
- circuit resistance tests
- pump replacement



	<b>Course Outcome 2</b>	<b>Learning Objectives for Course Outcome 2</b>
	<p>Upon successful completion the apprentice is able to recommend repairs for diesel fuel injection full-authority engine management systems following manufacturers' recommendations.</p>	<p>5.2.1 Explain the fundamentals of diesel fuel injection full-authority engine management systems.</p> <ul style="list-style-type: none"> <li>- applications</li> <li>- types</li> <li>- strategy</li> <li>- emission legislation</li> </ul> <p>5.2.2 Identify the construction features of full-authority electronic control diesel fuel injection systems and components.</p> <ul style="list-style-type: none"> <li>- sensors <ul style="list-style-type: none"> <li>speed <ul style="list-style-type: none"> <li>o crankshaft</li> <li>o camshaft</li> <li>o turbocharger</li> <li>o driveline</li> </ul> </li> <li>pressure <ul style="list-style-type: none"> <li>o engine oil</li> <li>o exhaust</li> <li>o intake manifold</li> <li>o atmospheric</li> <li>o fuel</li> <li>o injection actuation</li> <li>o cylinder</li> <li>o boost</li> </ul> </li> <li>temperature <ul style="list-style-type: none"> <li>o fuel</li> <li>o engine oil</li> <li>o exhaust</li> <li>o DPF</li> <li>o coolant</li> <li>o ambient air</li> </ul> </li> <li>position <ul style="list-style-type: none"> <li>o throttle</li> <li>o crankshaft</li> <li>o camshaft</li> <li>o EGR (exhaust gas recirculation)</li> <li>o VGT (variable geometry turbocharger) <ul style="list-style-type: none"> <li>- electronic unit injectors</li> </ul> </li> </ul> </li> <li>pulse width <ul style="list-style-type: none"> <li>poppet control valve</li> </ul> </li> <li>circuit protection <ul style="list-style-type: none"> <li>- hydraulic electronic unit injector (HEUI)</li> </ul> </li> <li>high pressure pump</li> <li>pressure regulator</li> <li>pressure sensor</li> <li>unit injector</li> <li>oil reservoir <ul style="list-style-type: none"> <li>- high pressure common rail</li> </ul> </li> <li>high pressure pump</li> <li>pressure regulator</li> <li>pressure sensor</li> </ul> </li> </ul>

time-pressure (PT) injector

- injector drivers
- status switches
- cruise control
- clutch and brake
- exhaust brake
- power take-off
- air brake
- electronic control module
- protection shut down
- limp home mode
- backup microprocessor

5.2.3 Describe the principles of operation of full-authority electronic control diesel fuel injection systems and components.

- sensors
- speed
  - o crankshaft
  - o camshaft
  - o turbocharger
  - o driveline
- pressure
  - o engine oil
  - o exhaust
  - o intake manifold
  - o atmospheric
  - o fuel
  - o injection actuation
  - o cylinder
  - o boost
- temperature
  - o fuel
  - o engine oil
  - o exhaust
  - o DPF
  - o coolant
  - o ambient air
- position
  - o throttle
  - o crankshaft
  - o camshaft
  - o EGR (exhaust gas recirculation)
  - o VGT (variable geometry turbocharger)
- electronic unit injectors
  - pulse width
  - pulse profile
  - poppet control valve
  - effective stroke control
  - time control
    - injector drivers
  - switching characteristics
  - spiked actuation
  - injector response time
    - hydraulic electronic unit injector (HEUI)



high pressure pump  
 pressure regulator  
 pressure sensor  
 unit injector  
 oil reservoir  
 - high pressure common rail  
 high pressure pump  
 pressure regulator  
 pressure sensor  
 time-pressure (TP) injector  
 - electronic control module  
 protection shut down  
 limp home mode  
 backup microprocessor  
 injector driver  
 cooling  
 power de-rate mode  
 data management  
 programming  
 power bulge

5.2.4 Perform inspection and diagnostic procedures following manufacturers' recommendations for full-authority electronically controlled diesel fuel injection systems.

- identify components and locations
- diagnostic techniques
- interpret electronic flow charts
- demonstrate the application of the electronic service tool (EST) and personal computer
- demonstrate reprogramming and uploading processes using a electronic service tool (EST)
- confirm electronic diagnosis with multi-meter testing

5.2.5 Recommend reconditioning or repair procedures following manufacturers' recommendations for full-authority engine management systems.

- describe connector seal assembly procedures
- outline checking procedures for electrical ground connection integrity
- outline boost starting procedures
- battery  
 charger  
 unit to unit

**Course Outcome 3**

**Learning Objectives for Course Outcome 3**

Upon successful completion the apprentice is able to interpret the exhaust emissions produced by diesel engines following manufacturers' recommendations.

5.3.1 Explain the fundamentals of diesel engine emission systems.  
 - properties  
 carbon monoxide  
 hydrocarbons  
 oxides of nitrogen  
 particulates  
 carbon dioxide



sulphur dioxide  
 aldehydes  
 - catalysts  
 oxidation  
 emission standards  
 federal regulations  
 provincial regulations  
 - aneroids  
 - altitude compensators  
 - sensors on emission controls

5.3.2 Demonstrate testing procedures following manufacturers' recommendations for diesel engine emission systems.  
 - inspecting emission control devices  
 - exhaust smoke analysis  
 light extinction methods  
 opacity meter  
 filtration/colour code method  
 - exhaust gas analysis  
 four gas analysis

**Evaluation Process and Grading System:**

Evaluation Type	Evaluation Weight
Shop Assignments	40%
Theory Test	60%

**Date:**

February 10, 2020

**Addendum:**

Please refer to the course outline addendum on the Learning Management System for further information.

